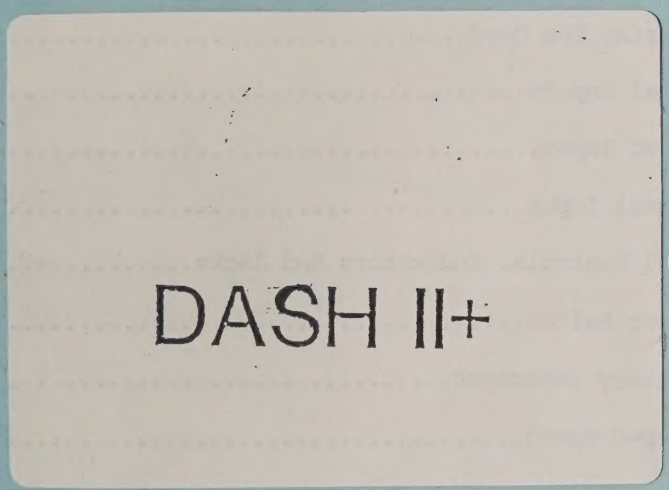
OPERATION AND SERVICE MANUAL



GRAPHIC RECORDERS

XTEK CORPORATION
15075 S.W. Koll Parkway, #C
Beaverton, OR 97006

Astro-Med, Inc.®

Astro-Med Industrial Park, West Warwick, Rhode Island 02893
Telephone (401) 828-4000 TLX No. 710-382-6409

DASH II+

CHAPTER 1.
OPERATING YOUR DASH II+

TABLE OF CONTENTS

Recorder Description.....1

Case.....1

Removing The Cover.....1

Reconnecting The Cover.....2

Storing The Cord.....2

Side Panel Inputs.....2

Power Input.....2

Signal Input.....2

Top Panel Controls, Indicators And Jacks.....2

Power Switch.....2

Battery Indicator.....2

Comp-U-Speed.....4

Remote Chart Jack.....4

Timer Control.....4

Events.....4

Gain Control.....5

Stylus Zero Control.....5

Trace Control.....5

Signal Conditioner Description.....6

Placement And Insertion.....6

Signal Conditioner Controls.....6

Attenuation.....8

Zero Suppression.....8

Peak-To-Peak/Root Mean Square.....10

Paper Load.....11

Start Up.....12

Battery Charge.....13

Recorder Description

CASE

The case is composed of two major pieces, the base and its cover. The cover stores the power cord and the base contains the recording unit. The case is designed so the cover can be removed and used as a paper tray.

Removing The Cover (See figures 1 and 1A)

1. Unlatch the cover

2. Face the back of the recorder toward you so the hinges can be seen

3. Lift the cover, with one hand, and hold it perpendicular to the base

4. Give the cover a quick, sharp slap, using your free hand, to separate the hinges and slide it to the left

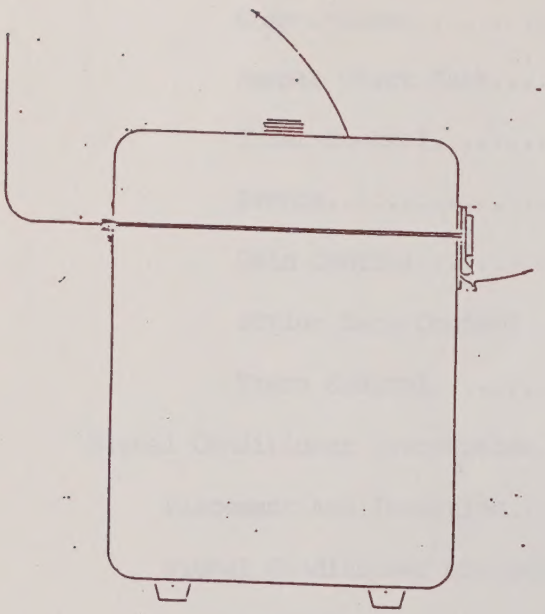


FIGURE 1. Lifting The Lid

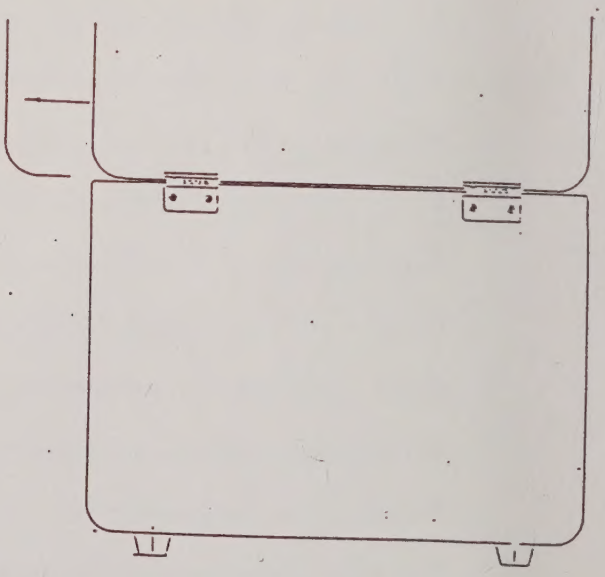


FIGURE 1A. Removing The Cover

Reconnecting The Cover

1. Face the back of the base toward you so the hinges can be seen

2. Hold the cover perpendicular to the base and align the hinges

3. Slide the cover onto the base until it clicks into place. The cover should slide on easily if it is properly aligned with the base

Storing The Cord

Be sure to wrap the line cord around all 4 prongs and insert both connectors into the two connector holders.

SIDE PANEL INPUTS AND CONTROLS (See figure 2)

1. Power Input

The power input connects the recorder to a source of AC power via the cable stored in the unit's cover.

2. Signal Input

Two 15 pin D connectors are used to input two signals from an outside source. They are also responsible for connecting an optional TC-200 to the system. (See the TC-200 manual for further details)

3. Circuit Breaker

The black circuit breaker protects your recorder from internal damage by turning off the unit when excess current is detected. If the power to your Dash II+ is suddenly cut, press the circuit breaker. This should reconnect your recorder with its power supply. Your system should be examined if this action reoccurs repeatedly.

TOP PANEL CONTROLS, INDICATORS AND JACKS (See figure 3)

1. Power Switch

The power switch, outlined in orange, turns on and off the power to the recorder. Be sure to turn it off before you plug in the power and signal cables.

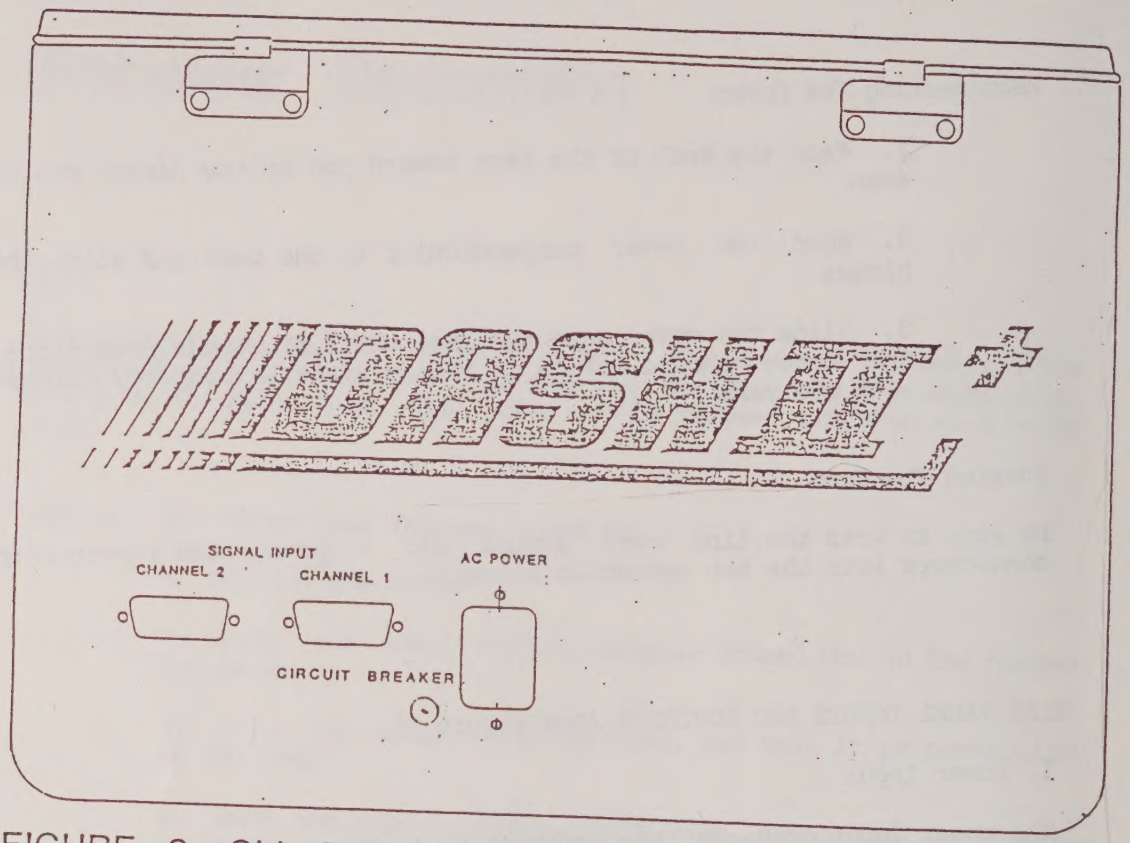


FIGURE 2. Side Panel Inputs And Controls

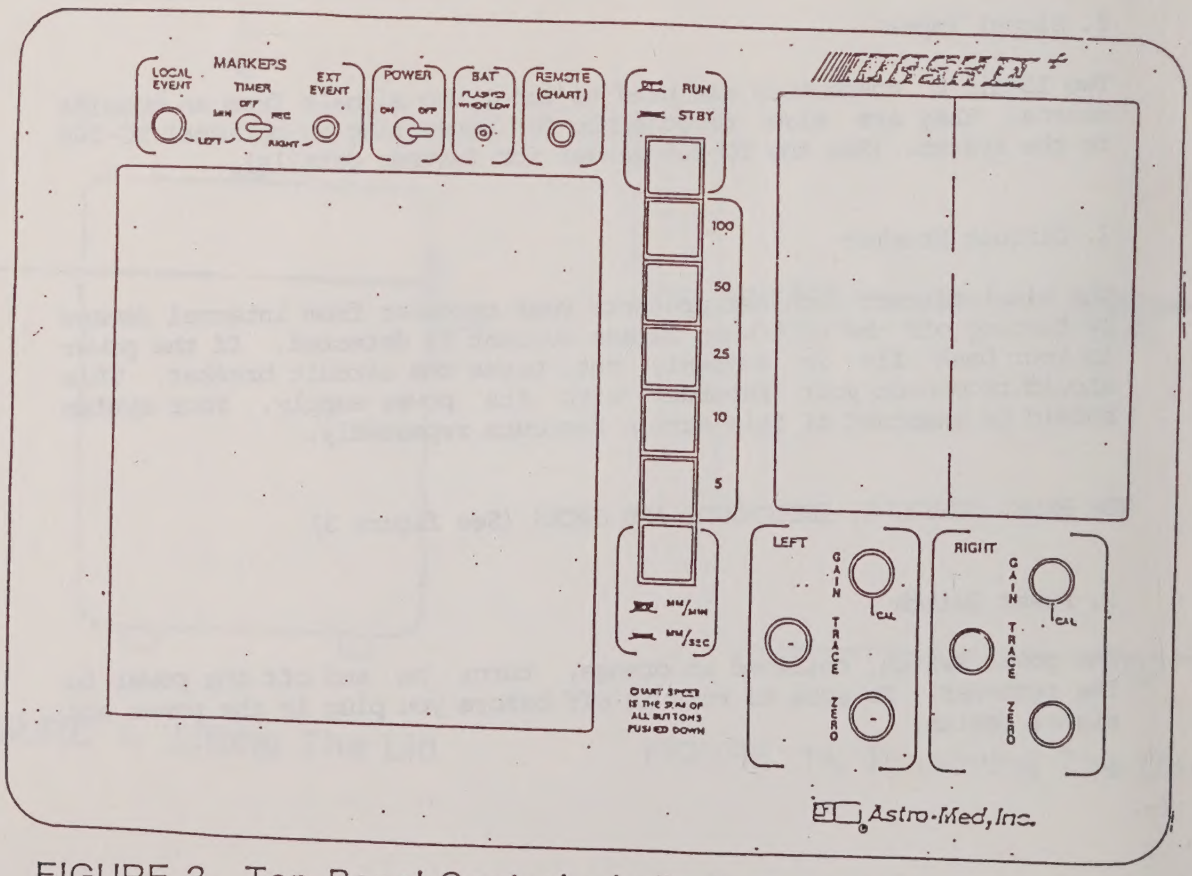


FIGURE 3. Top Panel Controls, Indicators And Jacks

2. Battery Indicator

The battery indicator, located beside the power switch, flashes when the battery is low.

3. Comp-U-Speed

a. Chart Speed Select

The color coded Comp-U-Speed selection switch allows you to choose chart speeds from 5 mm/min to 125 mm/sec. Located on the front panel the switch contains a mm/min-mm/sec selector (within the blue brackets) and five speed-select pushbuttons marked 5, 10, 25, 50 and 100. Since the chart speed is the sum of all of the buttons pushed down, 40 speeds may be obtained: 5, 10, 15, 25, 30, 35, 40, 50, 55, 60, 65, 75, 80, 85, 90 100, 105, 110, 115 and 125 mm/min and mm/sec. To set the speed, choose mm/min (blue) or mm/sec (orange) and press the appropriate speed-select pushbuttons. These pushbuttons will turn orange when activated.

b. Run/Standby with Remote Run

The top most button on the Comp-U-Speed switch (framed in blue brackets) determines whether the recorder immediately begins to record or waits in standby mode. This color coded switch enables you to quickly determine which mode the recorder is in. When the switch is up and is colored blue, the recorder is recording. When the switch is pushed in and colored orange, the system is on standby.

4. Remote Chart Jack

Enables you to operate the RUN/STBY switch from a distant location.

5. Timer Control

The 1 sec/1 min timer (blue switch) allows you to print timed spikes in the margin to the left of channel 1. Simply select either short 1 second pulses or long 1 minute pulses when the chart drive is operating in the mm/sec range or 1 minute pulses when the chart drive is operating in the mm/min range.

6. Events

The local event switch, and external event jack permit you to manually record significant events. The local event switch (black) gives you direct contact with the recorder. Simply press the switch to print a spike in the left margin beside channel 1. The spike's length is determined by the length of time you press the local event button. The remote jack enables you to log events from other locations. This spike is printed in the center margin and its length is also determined by the amount of time it's triggered.

The local event is connected to the timer switch. This enables you to concurrently print both timed and manually triggered spikes. For example, the timer is set to pulse at 1 minute intervals. You can still record an additional local event and the recorder will automatically continue to record the pulses at 1 minute intervals. Note: The timer operator is independent of event activation. This means that any local events entered do not affect the timing of the pulses.

The external event is not attached to the timer and will only record transmitted events.

NOTE: The following three controls are duplicated to provide two sets; one set for the left channel (channel #1) and the other for the right channel (channel #2).

7. Gain Control

The gain control should be rotated completely clockwise and set in the "CAL" position. This enables you to control the signal amplitude from the sensitivity switch on the signal conditioner. If the gain is moved out of the "CAL" position the signal amplitude will decrease.

8. Stylus Zero Control

Using the zero control, you can position the base line of the stylus anywhere within the channel. If a positive (+) signal is to be input with deflection to the left the stylus would normally be positioned toward the right margin. Conversely, minus (-) signals would be positioned towards the left margin for right deflection. Finally, signals with both positive and negative components would have the zero positioned near the middle of the channel.

9. Trace Control

The trace control sets the stylus heat level to give you a clear signal recording. Turn the knob clockwise for darker lines and counter clockwise for lighter ones. The trace density is then maintained via the heat control circuit which automatically compensates for changes in chart speed. This control is managed by a separate pen heat board.

Signal Conditioner Description

Two signal conditioners are needed to operate the Dash II+. The following instructions explain how to operate the recorder using the standard ASC-802 signal conditioners. Separate operating instructions are included with each additional unit from our line of signal conditioners.

PLACEMENT AND INSERTION

Each signal conditioner controls one waveform channel. The channel controlled is determined by the placement of the signal conditioner. The leftmost conditioner controls the leftmost channel and so on.

To insert the conditioner: (See figure 4)

1. Fully loosen the latch on the bottom of the conditioner by turning it counter clockwise

2. Align the signal conditioner with the signal conditioner chamber so the green board is partially inserted within the white slats which line the wall of the signal conditioner chamber.

3. Carefully slide the conditioner down into the chamber until it clicks into place.

DO NOT FORCE THE CONDITIONER INTO PLACE. If the conditioner does not slide into place easily, remove it from the chamber and realign it within the white chamber slats.

4. Turn the latch fully clockwise to lock the conditioner into place.

CAUTION: Never remove the signal conditioner by pulling on the 10 turn pot as breakage may occur. Use the latch to firmly slide the conditioner out of its chamber.

SIGNAL CONDITIONER CONTROLS (See figure 5)

The ASC-802 uses attenuation and zero suppression systems to scale a range of input signals from 50 mV - 2,500 mV and 5 V - 250 V. A peak-to-peak/root mean square switch offers you the option of charting the signal as it is actually input into the system, or converting it to its root mean square level.

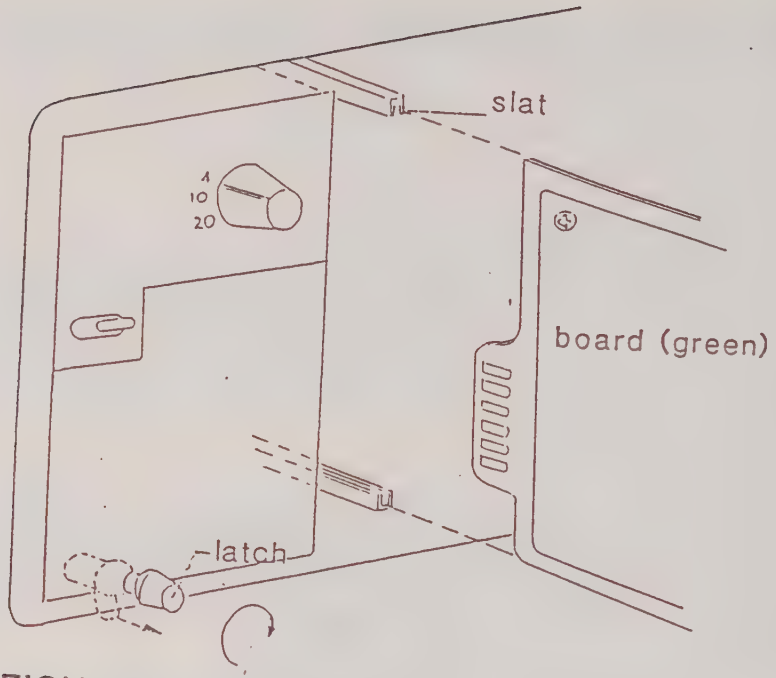


FIGURE 4. Inserting The Conditioner

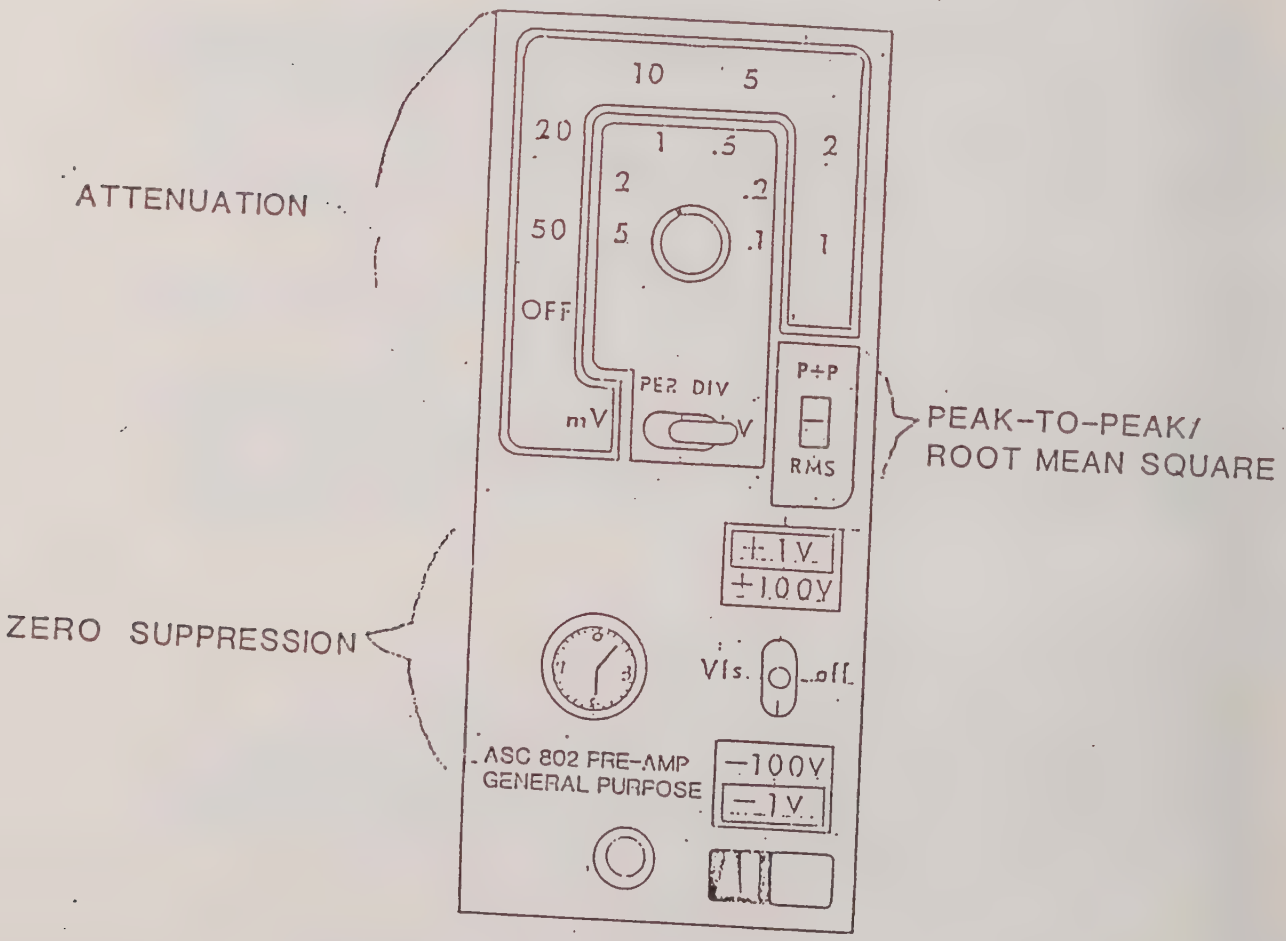


FIGURE 5. Signal Conditioner Controls

Attenuation

The attenuator controls, in the upper half of the conditioner, enable you to determine the number of volts or millivolts printed per division on the chart paper. This section consists of two controls, an attenuation knob and scale switch.

The scale switch relays the scale of the incoming signal to the signal conditioner. This switch contains two settings mV (orange) and V (white).

The attenuation knob determines the signal sensitivity (number of mV's or V's per chart division). There are 50 divisions per channel. Both the mV scale (orange) and volt scale (white) have six sensitivity settings. The mV settings include: 1, 2, 5, 10, 20 and 50 and the V settings include: .1, .2, .5, 1, 2, and 5.

To determine the scale per division:

1. Set the scale switch to match the incoming signal, mV or V

2. Divide the waveform amplitude by 50 (the number of divisions) to find the scale per division

3. Rotate the attenuator switch to this division number

Let's assume, for example, the full scale amplitude of your waveform is 100 volts. First you would set the scale switch to the V position. Next you would divide 100 by 50 to arrive at 2 V's per division and set the attenuation knob accordingly.

Zero Suppression

The zero suppression controls, on the bottom half of the conditioner facilitate waveform recording by permitting you to shift the zero point off of the chart. This section consists of two controls, a VSF switch and a 10 turn pot.

The VFS switch determines which direction the zero moves as it leaves the chart. Setting the switch in the + position shifts the zero point off the right side of the chart. Setting the switch in the - position shifts the zero off the left side of the chart.

The 10 turn pot determines how far the zero moves as it leaves the chart, thus determining the new base line value.

To shift the zero point off the chart:

1. Set the VFS switch to + or - to determine the direction of the shift

2. Rotate the 10 turn pot to set the new base line value

For example you may be recording a waveform with a 100 volt amplitude with a range of 25 to 125 volts. When a range of 0 to 100 is on the chart the top 25 volts of waveform amplitude can not be seen. To alleviate this situation set the VFS switch to the positive position and rotate the turn pot so it reads 25. (See figures 6 and 6A)

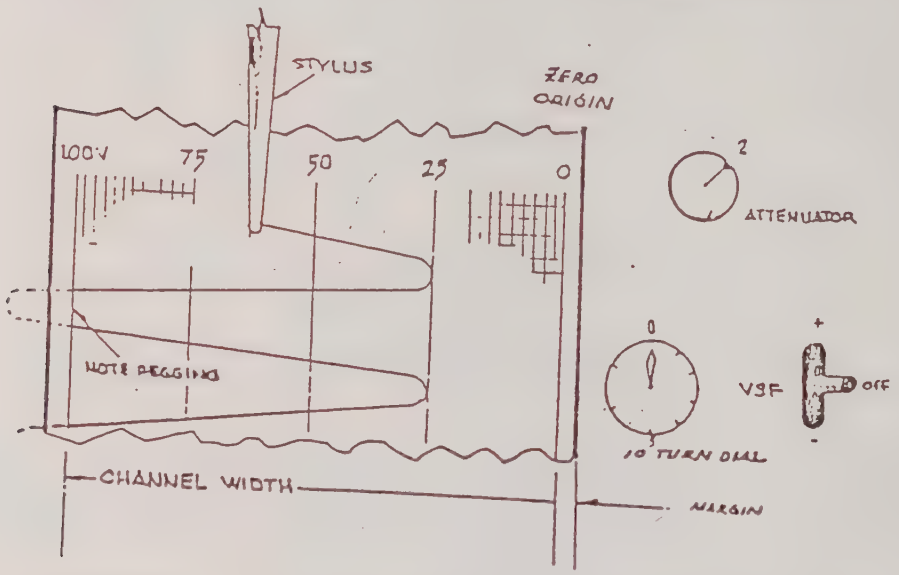


FIGURE 6. A Chart With No Zero Suppression

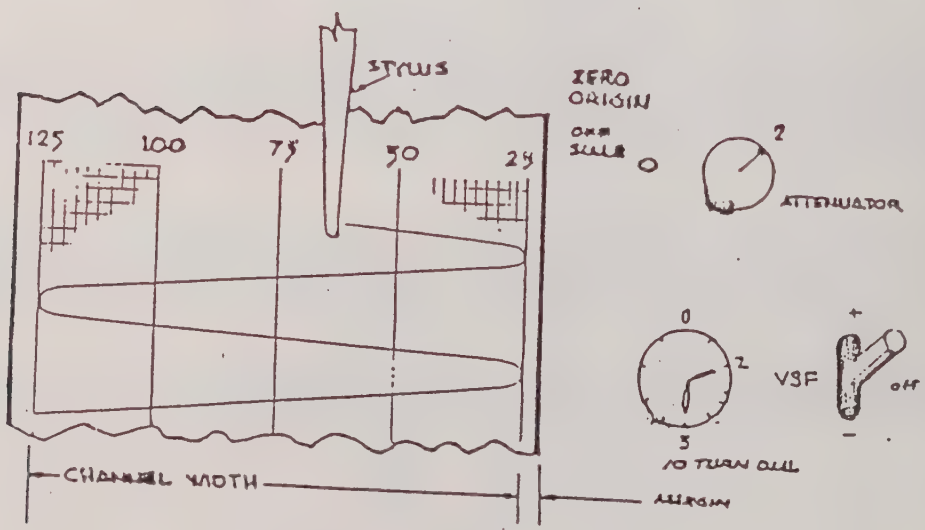


FIGURE 6A. A Chart With Zero Suppression

The zero suppression can also be used to magnify a particular division. For example a -36 to -37 signal volt range is input to the conditioner and the attenuator is set at 1 V per division. Studying an entire waveform the width of one division is cumbersome. The waveform can be magnified by setting the VFS switch to the negative position, to determine the direction the zero shifts; dialing 35 on the 10 turn pot, to set the new baseline value; and setting the attenuator to .1, to expand the waveform to 5 divisions. (See figures 7 and 7A)

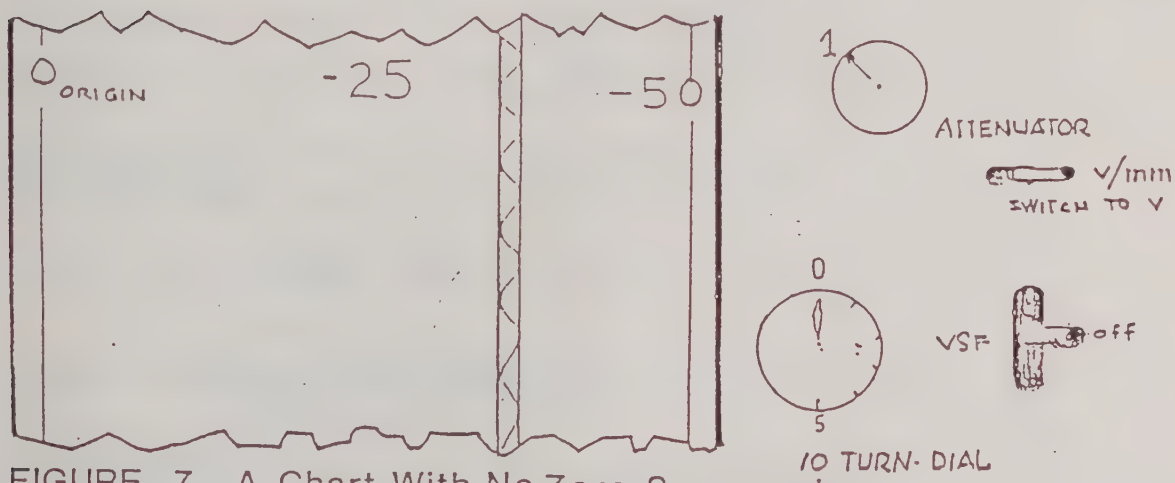


FIGURE 7. A Chart With No Zero Suppression

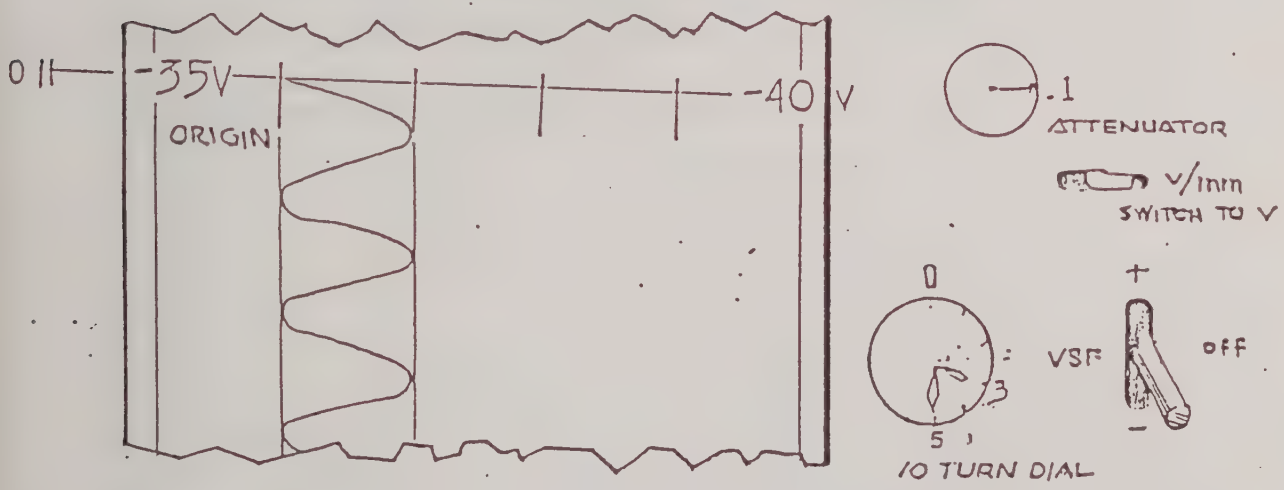


FIGURE 7A. A Chart With Zero Suppression

Peak-To-Peak/Root Mean Square

Either set the switch to P-P to record the actual signal as it is input, or RMS to convert the signal to the root mean square level and record it as a full scale representation, dependant upon the attenuation.

Paper Load

(See figure 8)

1. Remove the paper from its box

2. Lift up the paper bail bar and pull open the door

3. Insert the u-shaped spacer, base down, into the rear of the paper chamber (roll paper only)

4. Insert the paper into its tray so the red grid is facing the top of the recorder and the cut edge is facing the recorder door

5. Pull the paper out of the recorder and over the drive roller.

6. Hold up the paper and close the chart paper door, allowing the chart to hang out the front of the recorder

7. Lift up the paper bail bar so it creates a space between the pinch and drive rollers

8. Insert the free end of the paper down into the space between the pinch and drive rollers

9. Gently pull the paper into alignment and release the paper bail bar

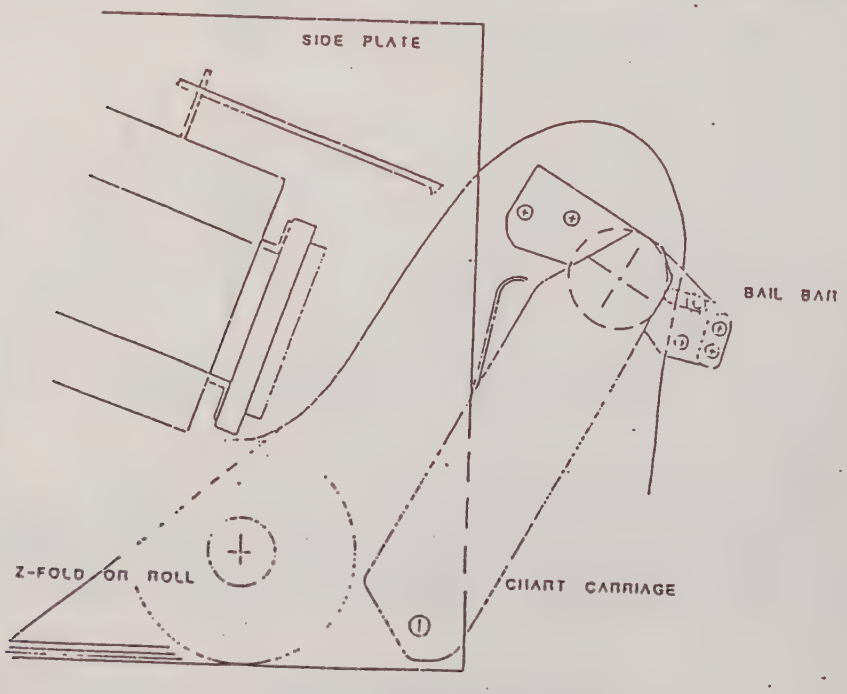


FIGURE 8. Loading The Paper (side view)

Start Up

1. Turn power switch off
2. Ready signal cables
3. Set RUN/STBY switch to "STBY" (orange)
4. Attach power cord, as necessary
5. Load Chart Paper
6. Turn timer off
7. Set Speed (suggest 25 mm/sec)
8. Set gain to "CAL"
9. Set RUN/STBY to "RUN" (blue)
10. Adjust trace and zero as necessary
11. Adjust the signal conditioner as necessary

Battery Charge

All Dash II+ units are fully charged when they leave the factory. Battery endurance is approximately 4 hours depending on the recorder's use. (See Power Supply in chapter 2 for more details)

Simply plug the Dash II+ into an AC source of power via the power cord, shut off the recorder's power switch and let it charge for 14 to 16 hours. A partially discharged battery may take fewer hours to recharge. The Dash II+ contains a charger board which prevents accidental overcharging.

You may also charge the battery via an AC line while the unit is operating. However, this method of charging takes longer because some of the power is being used to operate the recorder and is not being stored in the battery.

You may eventually need to replace the batteries. The batteries' life span is determined by their usage. A battery needs to be replaced when it no longer holds its charge and the recorder operates for only a couple of hours between rechargings. It is recommended that you replace both batteries at the same time. (See Battery Maintenance in chapter 3) Batteries ordered from the factory are not charged and need a full 14 to 16 hours of recharging before they are fully operational.

Components

1. MFGA Series Galvanometer

This basic, yet unique component of the Dash II+ is a moving coil D'Arsonval type galvanometer which depends not upon springs, but upon a simple closed-loop position feedback mechanism for its operation. The integral servo amplifier/drive constantly monitors the angular position of the galvo output shaft and compares that signal information to the signal at the input at the recorder. Any difference between where the position feedback transducer says the galvo coil is, and where the input signal says it should be is sensed immediately and corrected on a constant, dynamic basis by the servo amplifier. The closely machined components of this mechanism, and miniature ball-bearings at all pivot points, yield an overall galvo linearity of better than 99%, and a tested life of better than 50 million operations.

2. Point Writing Stylus

This important component is designed to be strong, light weight, and efficient. The low mass heating element demonstrates fast warm-up and fine tracings. Typical styli will achieve 20 million full scale operations.

3. Signal Limiter Assembly

This small printed circuit assembly plugs directly onto the galvanometer connector. It is adjusts to limit the amplitude of the input to the galvanometer for both positive and negative going signals.

4. DC To DC Converter System

This twin modular converter system changes the voltage from two 12 volt 4.5 amp batteries to the voltage required by the galvanometer. The first converter has two outputs. The first output is +/- 8VDC regulated to power the servo amplifier primary stages and the stylus. The second is +/- 30VDC unregulated to power the servo amplifier output stage and motor control. The second converter outputs +19VDC to the printer board.

5. Power Supply

The Dash II+ can be operated from an AC line or directly through its internal battery power supply. To operate via an AC line, simply connect the power cable, stored in the cover, from the recorder to an AC socket.

The Dash II+ can also be powered by two rechargeable 12 volt, 4.5 amp/hour gel-cell batteries which are connected in parallel within the case. No set up is necessary to operate off of the batteries. Simply turn on the recorder. Battery endurance is plus or minus 4 hours, however, this figure can vary widely depending on the conditions under which the unit is operated. High speed and heat, and complex signal waveforms require more power and result in a shorter operating span between charges. Cycling batteries, using the Dash II+ for a multitude of short spans rather than one long one, increases battery endurance.

6. Motor-Tachometer, Motor Control and Chart Speed Selection

a. Motor-Tachometer

The standard chart drive motor for the Dash II+ is D.C. operated with integral gear reduction. It is equipped with an A.C. output tachometer whose sinosoidal output frequency is 8 times that of the motor armature. The amplitude of the tachometer output varies with motor RPM, but the motor control ignores this.

b. Motor Control

In the motor control printed circuit board, an integrated circuit measures the output frequency of the motor tachometer, and produces a voltage which is linearly proportional to that frequency. The output of this "chip" is compared to the output of a voltage divider comprised of precision resistors. It is then inverted and fed to a transistor which controls the voltage to the DC motor. If the motor finds itself under load, the voltage output from the integrated circuit goes down as the frequency of the tachometer output goes down. The difference signal is inverted and appears at the motor as an increased voltage at the armature, etc.

This system allows better than 2% regulation of chart speed at any line voltage within its specified range, and at any line frequency.

c. Chart Speed Selection

The Dash II+ is capable of running at 40 speeds including: 5, 10, 15, 25, 30, 35, 40, 50, 55, 60, 65, 75, 80, 85, 90, 100, 105 110, 115 and 200. mm/min and mm/sec using Comp-U-Speed. You need only depress the appropriate color coded push-buttons.

7. Preamplifier

The pre-amplifier contains the Gain, Stylus Zero and Trace switches. By manipulating these controls you can adjust the signal format and modify the intensity of the signal recording.

8. Stylus Heat Compensation

Once the trace is set, the recorder will automatically maintain the trace density through a heat control circuit which automatically adjusts to meet changes in chart speed.

9. Event Driver Board

The independent internal event driver boards, when triggered, control the seven dot printheads. The recording will have a clear event spike(s) to document the trigger in the left margin of channel 1 and in between channels 1 and 2.

10. Timer

A front panel controlled timer circuit when activated in either the minute or second mode will produce an event spike on the left event margin.

Specifications

Number of Channels	Two plus two event markers
Channel Width	50 mm
Galvanometers	Closed loop position feedback servo system
Chart Supply	Z-fold pack sheets equaling 150 feet
Writing Method	Pointwriting on low cost thermal paper. Choice of blue or black imaging paper
Frequency Response	Flat to within 1 db full scale (50 mm) to 30 Hz. Flat to within 2 db at 10 mm peak to peak at 100 Hz
Linearity	Within 1% of full scale
Signal Input	15 Pin "D" Shell connectors; mate provided
Stylus Zero Control	Front panel potentiometer allows the base line (zero signal level) to be positioned anywhere within the channel
Stylus Heat Adjustment	Heat automatically adjusts according to chart speed. A front panel mounted manual adjustment is also provided
Drift	Less than 1 mm in 24 hours
Operating Temperature Range	0-50 C (32-122 F), 5-95% relative humidity. Non-condensing
Event Marker	Two event markers are provided; one local and one external. Local event operation is by external switch closure or by internal timer. External event operation is through an external event jack
Timer	A 1 sec/1 min timer provides short 1 sec pulses and long 1 min pulses when chart drive is operating in the mm/sec range. It provides 1 min pulses when in the mm/min range. Timer may be turned off with front panel switch

Chart Speeds	The Comp-U-Speed system provides 40 speeds from 5 mm/min to 125 mm/sec. The front panel push-button switch has a mm/min and mm/sec select button and five speed-select push-buttons marked 5, 10, 25 and 100 (non-interlocking). The chart speed is the sum of all the buttons pushed down. Thus the following speeds may be obtained: 5, 10, 15, 25, 30, 35, 40, 50, 55, 60, 65, 75, 80, 85, 90, 100, 105, 110, 115 and 125 mm/min and mm/sec.
Operating Modes	Operates from line or internal battery. Will operate without batteries installed.
Battery Charger and In-	Built-in charger recharges battery while in line operation. Flashing light indicates low battery.
Battery	Rechargeable gel type factory installed. Approximately 4 hours of operation between charges
Power Required	110/220 VAC; 50, 60 or 400 Hz
Weight	32 lbs. (14.5 kg) including batteries
Dimensions	Height: 12" (30.5 cm) Width: 10" (25.4 cm) Length: 13 1/4" (33.6 cm)
Color	Metallic silver case, black front panel with white, blue and orange lettering

The Dash II+ is furnished with a battery pack, AC line cord, and operating and service manual.

CHAPTER 3.
SERVICING YOUR DASH II+

TABLE OF CONTENTS

Preparatory Service And Maintenance Procedures.....19

Removing The Knobs.....19

Local Event Knob Removal.....19

Gain, Trace And Zero Knob Removal.....19

Reconnecting The Knobs.....19

Local Event Knob Connection.....19

Zero And Trace Knob Connection.....20

Gain Knob Connection.....20

Removing The Signal Conditioners.....20

Lifting The Chassis Out Of Its Case.....21

Returning The Chassis To Its Case.....22

Stylus Service And Maintenance.....24

Stylus Kit.....24

Removing And Replacing The Stylus.....24

Lapping The Stylus.....26

Adjusting The Stylus.....27

Stylus Tip Pressure Test.....27

Time Base Line Adjustment.....29

Rectilinear Adjustment.....30

Stylus Stroke Adjustment.....31

Galvanometer Service And Maintenance.....32

Removing And Replacing The Galvanometer.....32

Testing And Adjusting The Frequency Response.....33

Test #1.....33

Test #2.....34

Battery Maintenance.....35

Removing And Replacing The Battery.....35

Calibration.....36

In Case Of Difficulty.....37

Troubleshooting.....39

Preparatory Service And Maintenance Procedures

The maintenance following this section requires you to remove the Dash II+ chassis (recorder section) from its case. This procedure is composed of three major steps; removing the control knobs from the front panel, removing the signal conditioners and lifting the chassis out of its case. To make servicing the Dash II+ easier place it so its base is sitting on a firm surface, such as a table, and its front panel is facing upwards.

CAUTION: Disconnect the AC line from the unit before attempting to service.

REMOVING THE KNOBS

There are a total of seven knobs to remove before you can lift the face plate off of the chassis. They include the local event; and two sets of gain, trace and zero.

Local Event Knob Removal

1. Turn the local event knob counter clockwise until it slips off of its spindle

Gain, Trace And Zero Knob Removal

1. Pry the cap off of the knob
2. Turn the knob counter clockwise as far as it will rotate
3. Remove the screw (Use a #1 phillips or straight edge screw driver)
4. Lift the knob up straight off of the spindle
5. Store the knobs in a safe place

RECONNECTING THE KNOBS

The following instructions are included to explain how to reconnect the knobs after the maintenance is finished.

Local Event Knob Connection

1. Place the knob on the end of the spindle and turn it clockwise until it holds tight

Zero And Trace Knob Connection

1. Rotate the spindle clockwise until it will not turn anymore

2. Place the knob on the spindle and partially tighten

3. Use the hash mark to see if the knob rotates the same distance in either direction. (If the distance isn't equal loosen the knob, move it on the spindle and repeat this step)

4. Tighten the screw

5. Place the cap on top of the knob

Gain Knob Connection

1. Place the knob onto the spindle

2. Tighten the screw

3.Rotate the knob clockwise into calibrate. (You can hear a slight click when the knob is in calibrate)

4. Loosen the screw

5. Match the hash line to the calibration mark

6. Tighten the screw

7. Place the cap on top of the knob

REMOVING THE SIGNAL CONDITIONERS (See figure 9)

1. Unlock the latch by rotating it fully counter clockwise

2. Firmly pull the conditioner straight up and out of its chamber by the latch.

CAUTION: Never remove the signal conditioner by pulling on the 10 turn pot, as breakage may occur.

(See Placement And Insertion in chapter 1 for instructions on signal conditioner insertion)

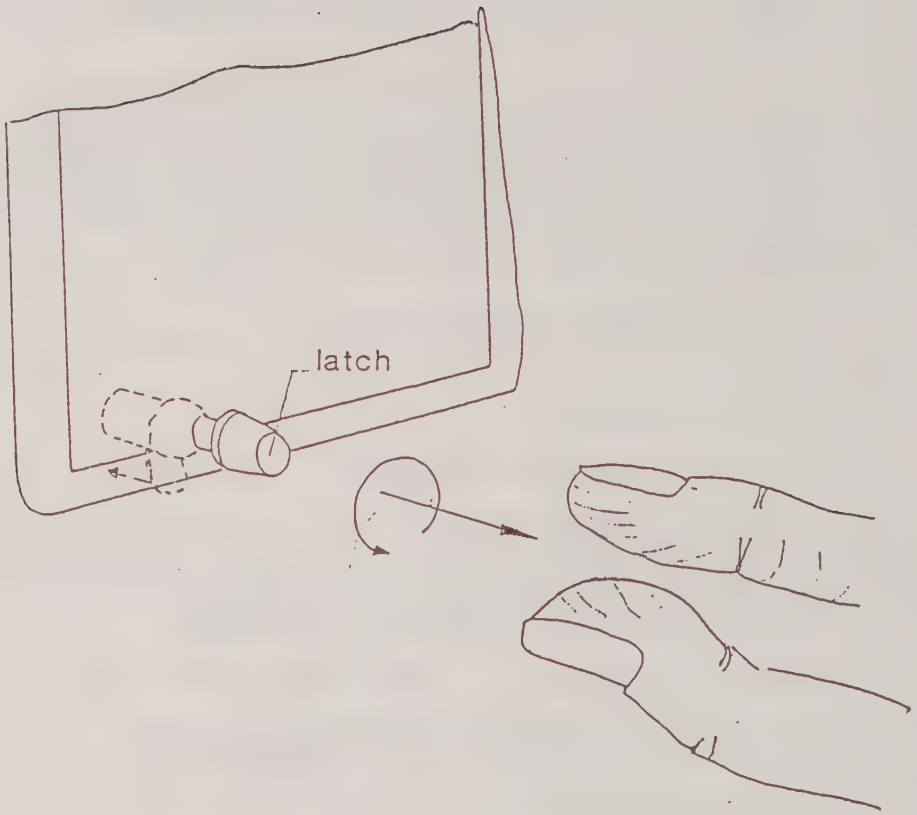


FIGURE 9. Removing The Signal Conditioner

LIFTING THE CHASSIS OUT OF ITS CASE

1. Unplug the AC power cord from the unit

2. Remove the 6 panel screws from the top face plate and lift it away

3. Remove the 4 side mounting bracket screws located on the top edge of the side panels

4. Lift the chassis out of its case (Be careful not to lift the chassis too high as it is still attached by a series of cables. You should set the recorder on top of its case in a diagonal manner so it rests firmly on the sides of the case)

5. Take the loose side brackets out of the unit and put them to one side

RETURNING THE CHASSIS TO ITS CASE

1. Unplug the AC power cord from the recorder

2. Place the side brackets back into their slots at the top of the case

3. Reconnect the four connectors from the chassis to the case if applicable

   - power to the unit (J3)

   - low battery (CP4)

   - 2 signal conditioner

4. Place the chassis into the case

5. Insert and tighten the 4 side mounting bracket screws on the top edge of the side panels

6. Replace the face plate and reconnect it using the 6 panel screws

7. Replace the knobs

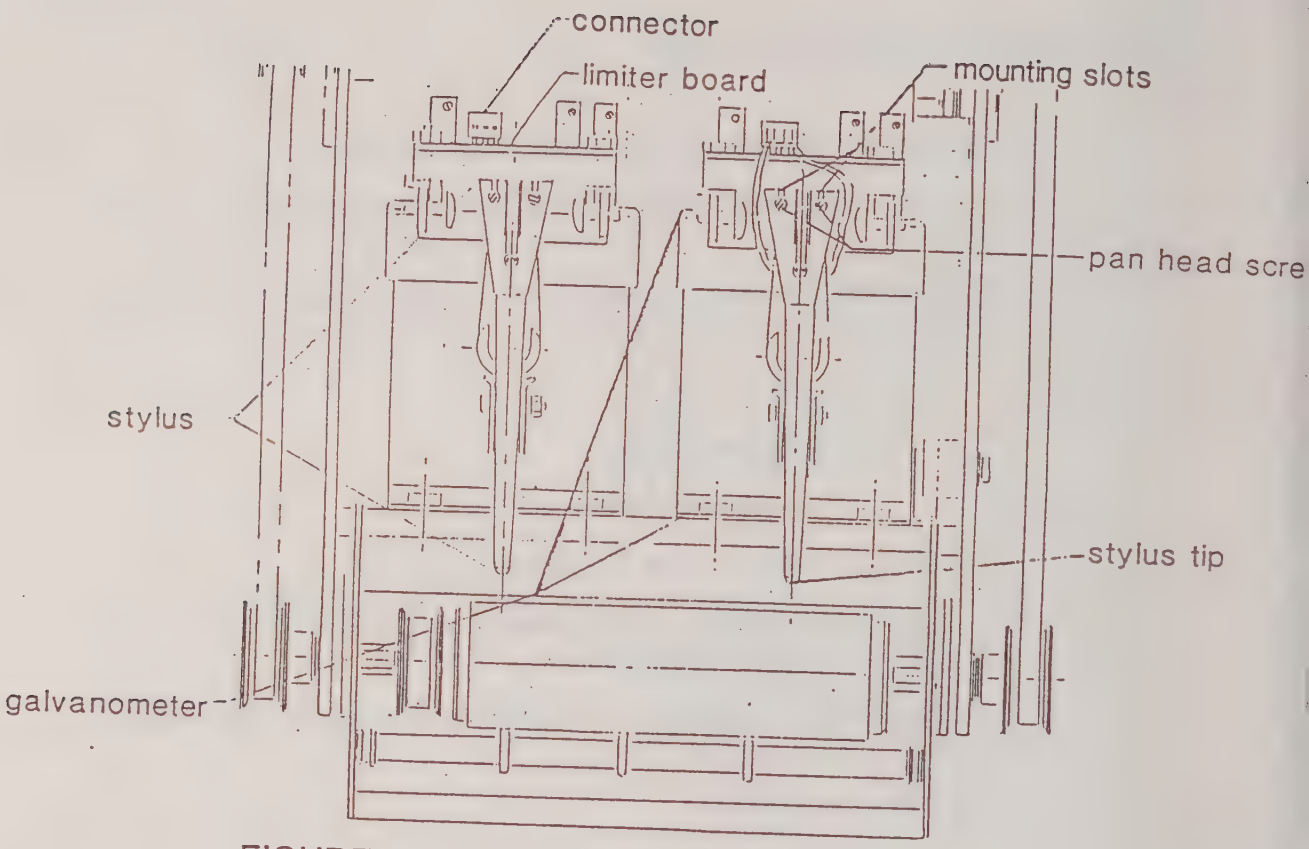


FIGURE 10. Identification Of Stylus And Galvanometer Parts (top view)

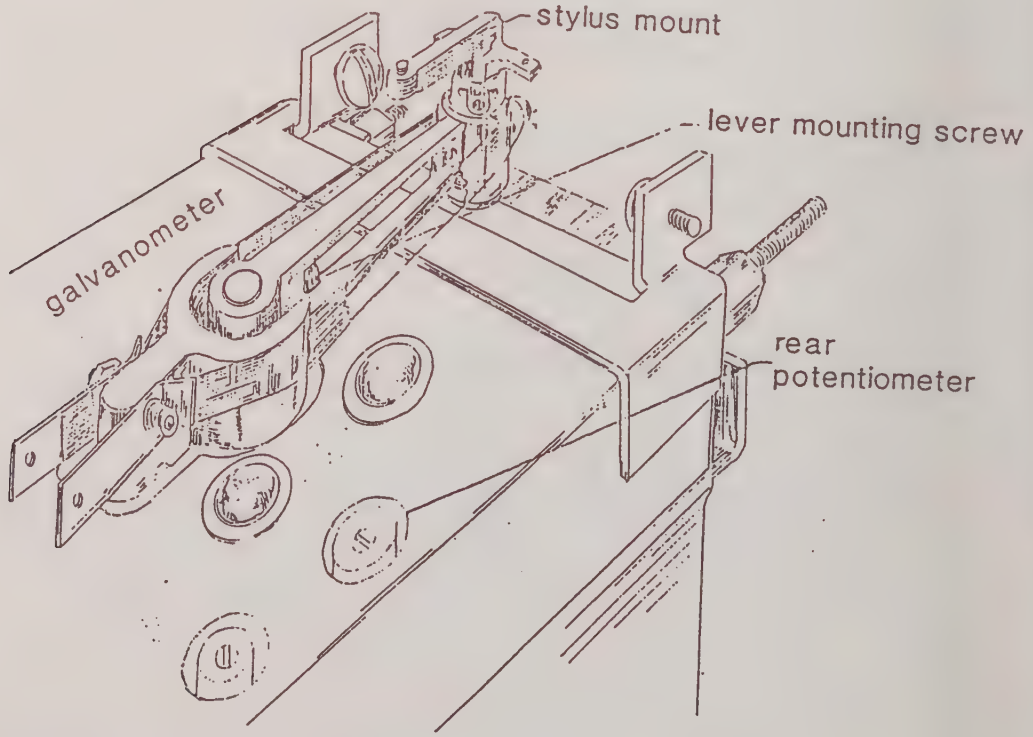


FIGURE 11. Identification Of Galvanometer Parts (exposed

Stylus Service And Maintenance

IDENTIFYING A WORN STYLUS

The pointwriting styli in this recorder will operate for several hundred hours under normal operating conditions. Replacement of a stylus becomes necessary when it is damaged or trace becomes unreadable. A light or unreadable chart trace will persist even after adjustment of the stylus heat "trace" control is rotated to the full clockwise position.

STYLUS KIT

Use the Astro-Med Model PSAK-62 replacement stylus, found in Stylus Kit Number 20695-094. The kit contains one each of the following items (with instructions):

a. Stylus, Pointwriting, Part Number 20695-002

b. Lapping Paper, 600 Grit, Part Number 11624-625

c. #1 Bristol Spline Key, Part Number 11623-001

REMOVING AND REPLACING A WORN STYLUS (See figures 10 and 11 for identification of parts)

NOTE: Replace only one stylus at a time. One untouched stylus is needed as a basis for comparison.

1. Plug in the AC line cord

2. Load paper into the Dash II+

3. Turn the recorder on and run 3 feet of paper before following the rest of this procedure

4. Move the worn stylus tip to the 25mm line using the zero control

5. Turn the trace down

6. Set the unit into "STBY"

7. Open the door to the paper compartment

8. Loosen the two pan head screws at the rear of the stylus assembly

9. Unplug the connector from the limiter board and remove the stylus through the open door

10. Insert a new stylus so the mounting slots (at the rear of the stylus assembly) are under the two pan head screws

11. Turn the pan head screws until the stylus is loosely held into place

12. Close the paper compartment door

13. Turn the recorder on and run 3 more feet of paper

14. Move the stylus assembly in and out, so the screws slide within the mounting slots, until the stylus is resting on the same cross line as the adjacent channel. (See figure 12)

15. Manually move the stylus to the 25 mm line

16. Tighten the pan head screws to the stylus assembly

17. Plug the connector into the limiter board

18. Turn the recorder on at 25 mm/sec

19. Turn the trace up as necessary

20. Set the recorder in "STBY"

21. Check the time base line to the base line of the neighboring channel. If the baselines do not match repeat this process starting with step 11. If you lose your original 25mm line reference, see "Time Base Line Adjustment" and "Rectilinear Adjustment" outlined in "Stylus Adjustments"

22. Lap the stylus. See "Lapping The Stylus"

23. Check the stylus pressure as outlined in "Stylus Adjustments"

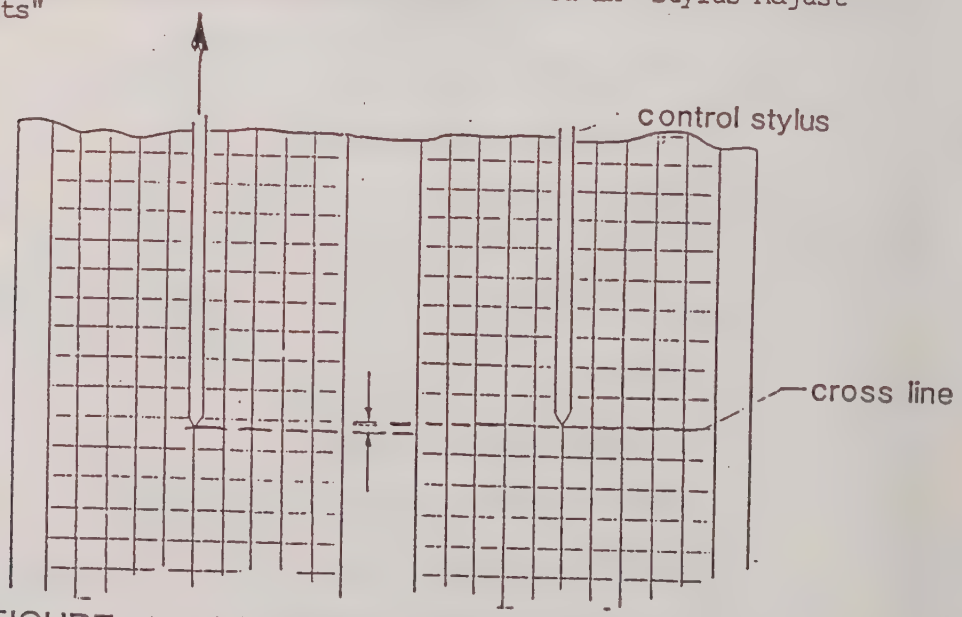


FIGURE 12. Aligning The Time Base Line

LAPPING THE STYLUS

After installation, the stylus tip must be lapped to remove any sharp edges and to insure proper contact with the chart paper. (See figure 13)

1. Connect the stylus channel to signal generator (if one is available)

2. Insert the lapping paper between the writing bar and stylus tip

3. Set the signal generator to 5 Hz for full stylus amplitude (movement)

4. Start the signal generator (if applicable)

5. Continuously pull the paper outward so the paper traverses a new paper section for each stroke. Let the stylus stroke the paper for 25 complete oscillations.

When a signal generator is not available, the stylus can be moved manually. Move the stylus by placing a finger on the rear of the stylus mounting bracket and pushing the assembly back and forth. To avoid an improperly lapped stylus, do not push the stylus close to the tip.

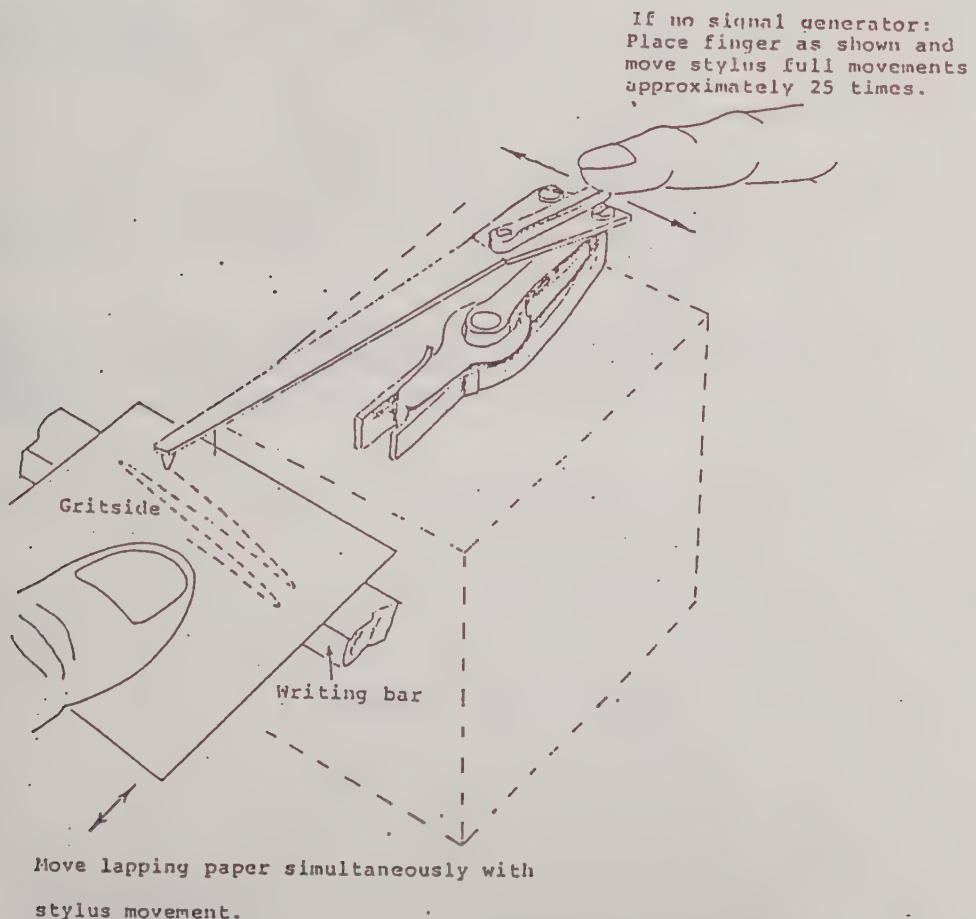


FIGURE 13 Lapping The Stylus

ADJUSTING THE STYLUS

The following four adjustments are only necessary when recommended by the "Removing And Replacing The Stylus" section or after you replace a galvanometer.

Stylus Tip Pressure Test

A Bristol Spline Key (supplied in the stylus kit) and a 0-50 gram scale, Chatillion Brand or equivalent, with a small hook added to grasp the stylus tip is needed to ascertain the correct stylus force.

1. Run the recorder at 5mm/sec

2. Position the stylus to the right side of the chart using the zero control

3. Gently place the hook under the end of stylus bar and lift the stylus until it just loses contact with the paper.

4. Note the stylus pressure

5. Position the stylus to the left side of the chart using the zero control

6. Gently place the hook under the end of stylus bar and lift the stylus until it just loses contact with the paper. (See figure 14)

7. Note the stylus pressure

8. Calculate the average of the two measurements. The average should be 25 grams, + or - 5 grams. If it is, discontinue this exercise, if it isn't, follow the rest of these instructions.

9. While holding the galvanometer, remove the 4 #6 binder head screws which hold the galvanometer in place. (A stubby or offset screwdriver may be used to remove the two bottom screws)

10. Slightly tilt the galvanometer towards the low pressure side of the chart. (See figure 15)

11. Replace the 4 mounting screws and tighten them

12. Remeasure and calculate the stylus force

13. Repeat procedure until satisfied

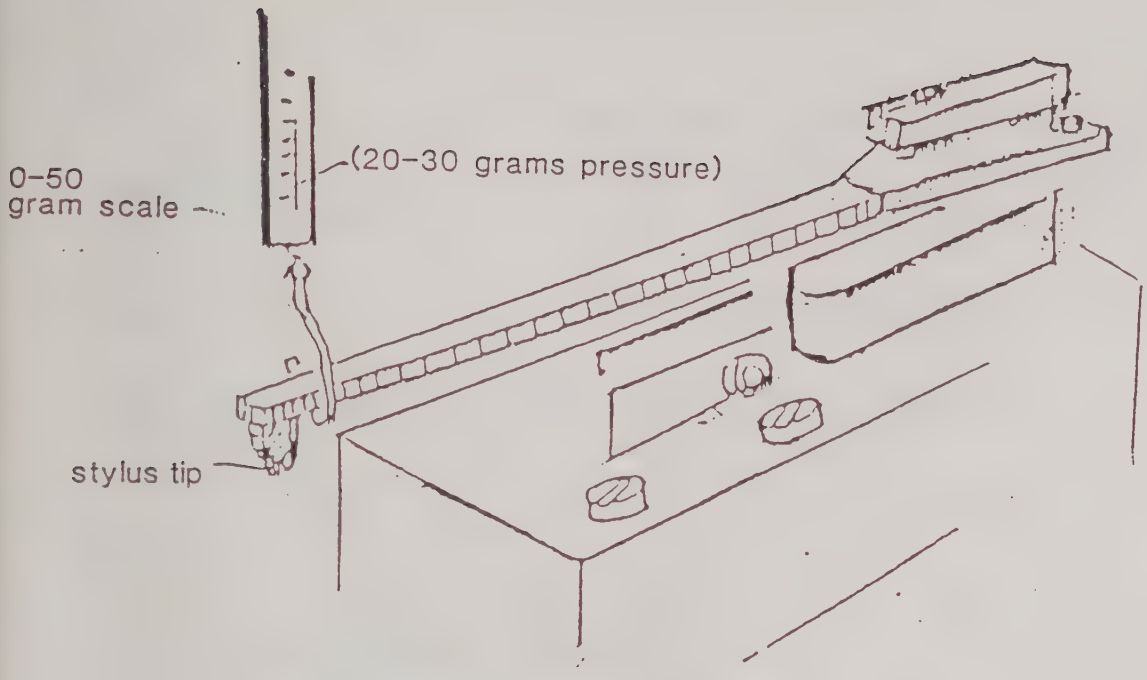


FIGURE 14. Measuring Stylus Tip Pressure

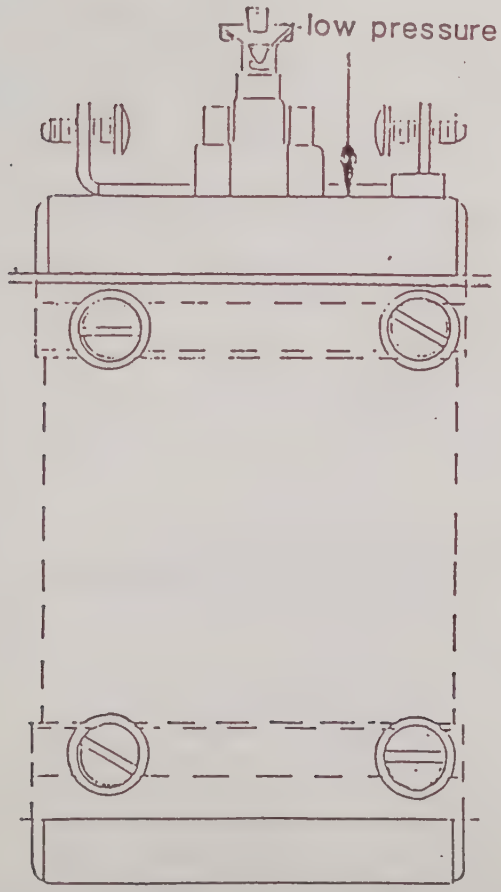


FIGURE 15. Adjusting The Galvanometer

Time Base Line Adjustment (See figure 16)

Time line errors are caused when a stylus is not on the same cross line as the pen in the other channel. A tolerance allowance of + or - .50 mm is acceptable.

1. Loosen the pan head screws at the rear of the stylus assembly as necessary

2. Move the stylus assembly in and out, so the screws slide within the mounting slots, until the stylus is resting on the same cross line as the adjacent channel

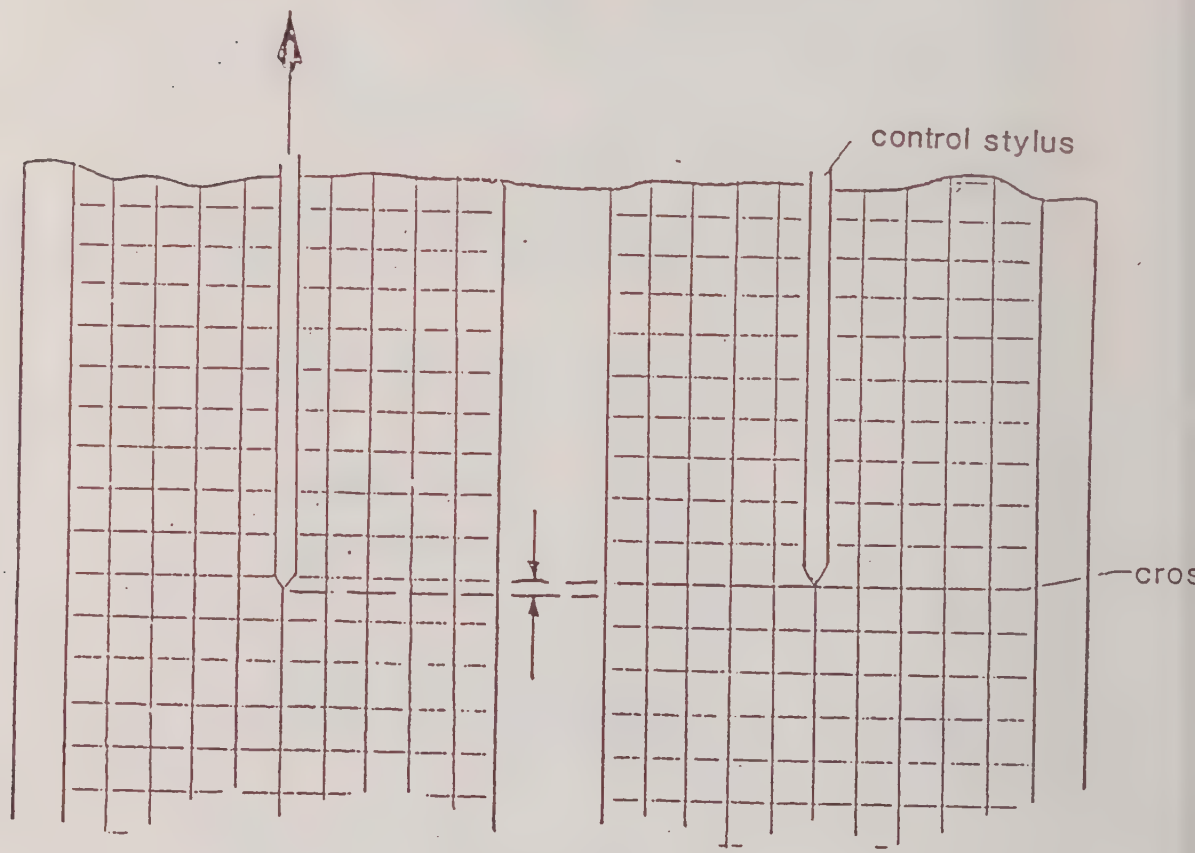


FIGURE 16. Adjusting The Time Base Line

Rectilinear Adjustment (See figure 17)

Rectilinear errors are caused when the pen can not draw straight lines parallel to chart cross lines. A tolerance of + or - .25 mm is allowed.

1. Turn the recorder on to 5mm/sec

2. Stop the recorder when the stylus rests on a major cross line

3. Draw a line over the cross line from one side of the channel to the other using the zero control

4. If the stylus line matches this major chart line, or is within .25mm, disregard the following procedures. If the lines don't match continue to follow these instructions.

5. Count the number of divisions at the widest point between the chart line and where the stylus actually drew the line and subtract the number of divisions in the most narrow point

6. Multiply the number of divisions by two = X

7. Manually move the stylus X divisions towards the side of the chart where the stylus drawn line is closest to the galvanometer

8. Tighten the lever mounting screw

9. Tighten the pan head screws at the rear of the stylus assembly

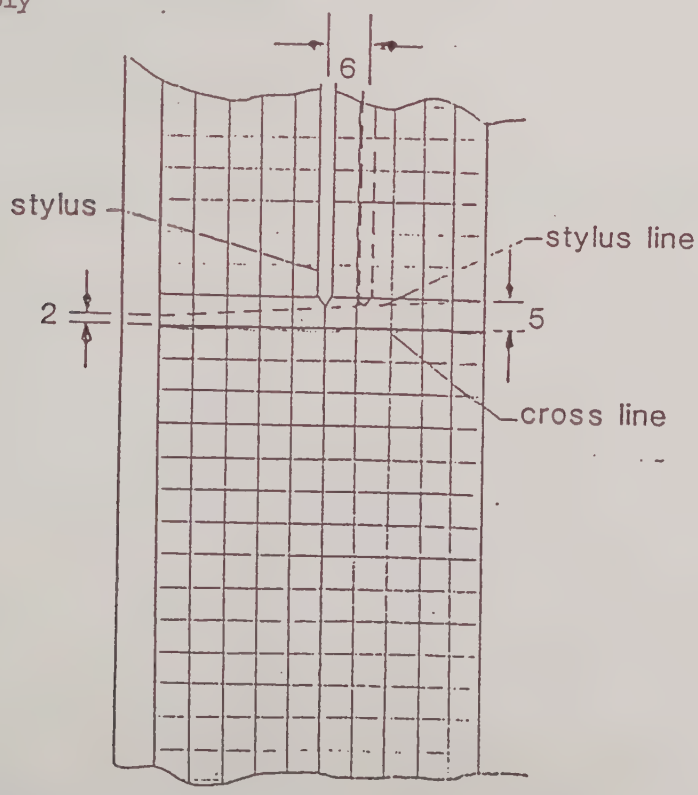


FIGURE 17. Adjusting The Rectilinearity

• each block = 5 divisions

Stylus Stroke Adjustment

The stylus stroke (or distance traveled) is controlled electronically by the limiter board. Mechanical, nylon screws stops are also provided in the event of limiter board failure. These are located at the rear of the galvanometer. Be sure these are positioned so they will not interfere with electronic limiter adjustments.

Galvanometer Service And Maintenance

REMOVING AND REPLACING THE GALVANOMETER

NOTE: Replace only one galvanometer at a time. One untouched galvanometer and stylus is needed as a basis for comparison.

1. Open the door to the paper compartment

2. Loosen the two pan head screws at the rear of the stylus assembly

3. Unplug the connector from the limiter board and remove the stylus through the open door

4. Remove the limiter board (fastened to galvanometer by 2, 4-40 hex nuts)

5. While holding the galvanometer, remove the 4 #6 binder head screws which hold the galvanometer in place. (A stubby or offset screwdriver may be used to remove the two bottom screws)

6. Carefully remove the galvanometer through the opening in the back of the chassis

7. Carefully insert a new galvanometer

8. Replace the 4 mounting screws and tighten them until the galvanometer is loosely held into place

9. While pressing the galvanometer down, fully tighten the mounting screws to assure even stylus pressure. (See figure 18)

10. Reinsert the stylus as described in "Removing And Replacing The Stylus"

11. Readjust the stylus following the procedures listed in "Adjusting The Stylus"

12. Test the frequency response if desired. (See Testing And Adjusting The Frequency Response)

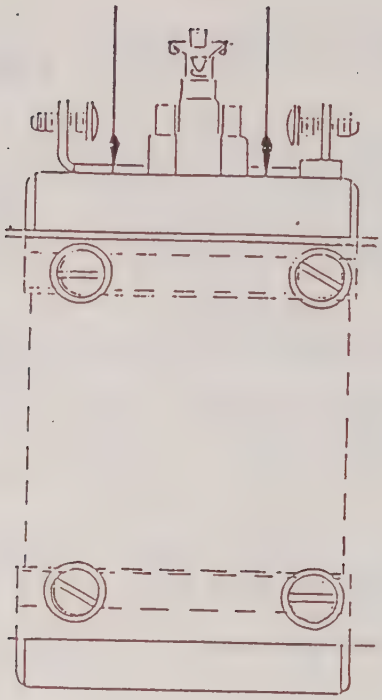


FIGURE 18. Pressing Down The Galvanometer

TESTING AND ADJUSTING THE FREQUENCY RESPONSE

The frequency response should only be tested after a galvanometer is replaced and even under these conditions the response is accurate 80% of the time. You need a function generator and spline key to perform this function.

Test #1

1. Set the generator to 1 Hz square wave

2. Set the speed to 5 mm/sec

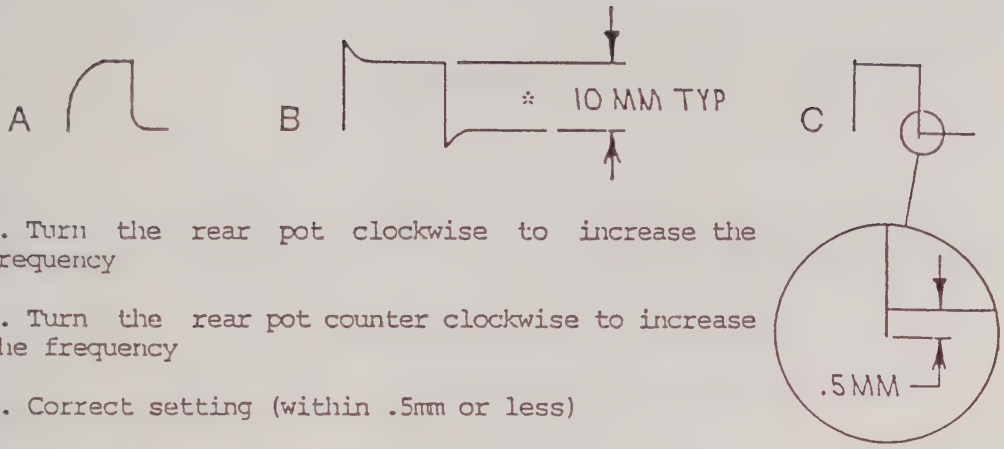
3. Center the stylus tip at the 25 mm line using the zero control

4. Slowly turn the gain control until the trace becomes a 10 mm square wave

5. Set the unit on "STBY"

6. Compare the trace to the chart (Figure 19)

7. Adjust the rear potentiometer on the galvanometer as necessary



A. Turn the rear pot clockwise to increase the frequency

B. Turn the rear pot counter clockwise to increase the frequency

C. Correct setting (within .5mm or less)

FIGURE 19. Sample Waveform Frequency Responses

Test #2 should be performed to verify proper frequency response adjustment.

Test #2

1. Set the generator to 10 Hz sine wave
2. Set the recorder at run (5mm/sec)
3. Increase the sine wave from 10 Hz to 50 Hz to 100 Hz in a smooth succession
4. Set the unit on "STBY"
5. Compare the trace to the following table (Figure 20)
6. Adjust as necessary

Each frequency should be of the following amplitude:

10 Hz. = 10mm
50 Hz. = 9.5 to 10.5 mm (typically 10 mm)
100 Hz. = no less than -7 mm (typically more than 8 mm)

A. Turn the rear pot clockwise if the trace frequency is lower than the figures listed in this table

B. Turn the rear pot counter clockwise if the trace frequency exceeds the figures listed in this table

FIGURE 20. Permissible Frequency Resposes For Test #2

Battery Maintenance

REMOVING AND REPLACING THE BATTERY

1. Unplug the AC power cord from the unit

2. Unplug the four connectors tieing the chassis to the case

   - power to unit (J3)

   - low battery (CP4)

   - 2 signal conditioner

3. Lift the chassis away from its case

4. Unplug the connector to the batteries from the charger section

5. Remove the 2 bolts holding down the black battery plate by unscrewing the 2 nuts

6. Lift away the battery plate. (Be careful not to touch the plate against the battery terminals)

7. Pull away the 3 white pieces of packing foam

8. Remove the batteries from the case and set them on the table in front of you

9. Place the new batteries beside the old and connect, one at a time, the corresponding leads from the old batteries to the new ones

10. Do the opposite of these steps in descending order, from 8-1, to complete battery replacement.

Calibration

Since all Astro-Med recorders are completely factory calibrated following the National Bureau of standards' guidelines no further calibration is necessary.

In Case Of Difficulty

This section is provided to assist you in diagnosing and correcting simple problems caused by inaccurate recorder adjustment. If problems persist, see "Troubleshooting" for solutions to internal recorder malfunctions.

PROBLEM	PROBABLE CAUSE	SOLUTION
Chart drive won't function	Run/Standby switch in "standby" position	Press switch into up "blue" position
	Cable may be inserted into Remote Chart Drive jack	Remove cable or turn remote switch on
	Paper switch protruding through perforated holes	Pull paper lead extending out from under the crossbar until performation appears
One-second event marker fails to operate	Cable plugged into event channel jack	Remove cable
	One-second/minute switch not on	Turn on One-second/minute switch
No stylus trace/light stylus trace	Trace setting too low	Increase trace setting
Poor signal response	Filter on signal conditioner is on	Turn off filter
Stylus pegs to one side	Zero suppression control on signal conditioner is on	If zero suppression over-powers gain at a particular setting, turn zero suppression to "off" position or adjust zero suppression as needed

PROBLEM	PROBABLE CAUSE	SOLUTION
No power to recorder	AC line cord not connected to unit	Connect cord
Power to recorder but will not run	Paper improperly threaded	Repeat paper feed sequence
	Battery is dead	Wait a few minutes after AC plug in. Recorder will start on its own

Troubleshooting

This section is provided to help you diagnose and solve problems stemming from internal recorder malfunctions. Since many problems are caused by maladjusted recorder controls, be sure to review "In Case of Difficulty" before continuing this section.

The Dash 2+ is designed so each channel has its own limiter board (21686001), galvanometer (40540002), power supply (20926011) & (20926012), harnessing, and interface board containing a trace control board and gain and zero control knobs (22068002). Thus it is possible to isolate problems by testing components crosswired to neighboring channels. For example, an apparently inoperative gain switch on channel x can be checked by switching with a neighboring harness. If problem now appears in neighboring channel, replace component or assembly. Note: Instructions for technical adjustment and replacement of parts are included throughout this chapter.

CAUTION: Disconnect the AC line from the unit before attempting to service.

PROBLEM	PROBABLE CAUSE	SOLUTION
Power to recorder but will not run	Chart carriage closed without chart paper.	Insert paper
	Interlock switch arm broken	Replace switch
	Paper improperly threaded	Repeat paper feed sequence
No power to recorder	Break or open circuit in power cord	Replace cord
	Defective receptacle	Check main power supply/receptacle
	Overload	Reset circuit breaker
	Cable from case to recorder chassis disconnected	Connect cable
No stylus trace	Defective stylus	Test stylus: disconnect stylus connector and swap with neighboring stylus connector. If stylus still does not work, replace stylus

APPENDIXES

TABLE OF CONTENTS

Appendix A. Warranty.....45

Appendix B. Replacement Parts.....46

Appendix C. Drawings.....47

PROBLEM	PROBABLE CAUSE	SOLUTION
	Cable from limiter board to control board disconnected	Connect cable
	Defective cable from limiter board to control board	Test cable: disconnect and swap with neighboring cable. If stylus now works, replace cable
	Insufficient stylus force	Check stylus for 20 to 30 grams
No stylus response	Loose lever	Re-zero and tighten Caution: NEVER OPERATE POSITION CONTROL WHEN PIN 2 IS SHORTED TO GROUND 1. Set position control to center 2. Short pin 2 of 1 + pin connector on control board to ground 3. Set attenuator switch to "off" 4. Run recorder and set pen to center of grid. 5. Tighten screw on lever
	Power supply failure	Test power supply assembly: meter limiting board by following schematic to find missing voltage. Replace as necessary
No chart drive	Paper out switch not engaged properly	Reload and realign paper

PROBLEM	PROBABLE CAUSE	SOLUTION
Printhead does not work or is missing consecutive lines of dots	Defective printhead	Test printhead: plug printhead into neighboring socket. If printhead still does not function, replace printhead
	Defective driver board	If printer works when plugged into neighboring socket, replace driver board
Printhead fails to print timing pulses	Defective timer board	Test timer board: Set timer switch into second mode Observe transistor collector (on timer board) with meter (preferably analogue) for pulses at rate of one per second
Galvanometer does not respond to signal		Note: Gain control should be in "CAL" position, attenuator switch must be on, and zero suppression knob turned off
	Defective input cables	Input cables could be open. Replace input cable
	Loose input cables	Securely fasten input cables from rear panel to signal board
No stylus position control in channel	Defective galvanometer	Test Galvanometer: switch harness cable from working galvanometer. See Sec. V, Service
	Disconnected cable from limiter board to control board	Connect cable

PROBLEM	PROBABLE CAUSE	SOLUTION
	Defective cable from limiter board to control board	Disconnect and swap with neighboring cable. If stylus now works, replace cable
Stylus pegs left or right	Defective galvanometer	Test Galvanometer: switch harness cable from working galvanometer. See Sec. V, Service
	Power supply is not outputting +/- 8 volts	Test power supply: meter limiting board by following schematic to find missing voltage Replace power supply as necessary
	Defective control board	Test control board: disconnect control board cable and crosswire using neighboring cable Note: tie wraps must be removed
	Defective limiter board	Test limiter board: disconnect cable and crosswire using neighboring cable. Replace control board if still inoperable
No galvo response (1 galvo)	Defective galvo, limiter board, control board or power supply	Test galvo/limiter board: crosswire harness from neighboring limiter board. To isolate defective galvo or limiter board, switch the 2 limiter boards. If same galvo remains inoperative, galvo is defective. Replace galvo If original galvo functions and neighboing galvo malfunctions, limiter board is defective. Replace limiter board

PROBLEM	PROBABLE CAUSE	SOLUTION
		Test control board: disconnect control board cable and cross-wire using neighboring cable. Replace control board if still inoperable
		Test power supply: meter limiting board by following schematic to find missing voltage Replace power supply as necessary
Galvo does not reach baseline	Trimpots are mal-adjusted	Adjust stylus limit potentiometer on limit board counter-clockwise until galvo reaches desired point
		Left baseline: adjust left trimpot on limiter board
		Right baseline: adjust right trimpot on limiter board
		*Do not touch center trimpot
		Note: be sure gain pot is turned off and position pot is turned all the way left or right
	Defective control board	Test control board: see "No galvo response"
	Cables broken/ connections loose	Check all cables and connections
	Interlock jammed in place	If no galvos respond, make sure interlock (in side paper area) is not hung up.

PROBLEM	PROBABLE CAUSE	SOLUTION
Signal is excessively noisy	Input ungrounded	Properly ground input

Appendix A. Warranty

The Dash II+ carries a 1-year warranty against defects in material or workmanship. Repairs performed during the first year must be done at the factory to honor the warranty.

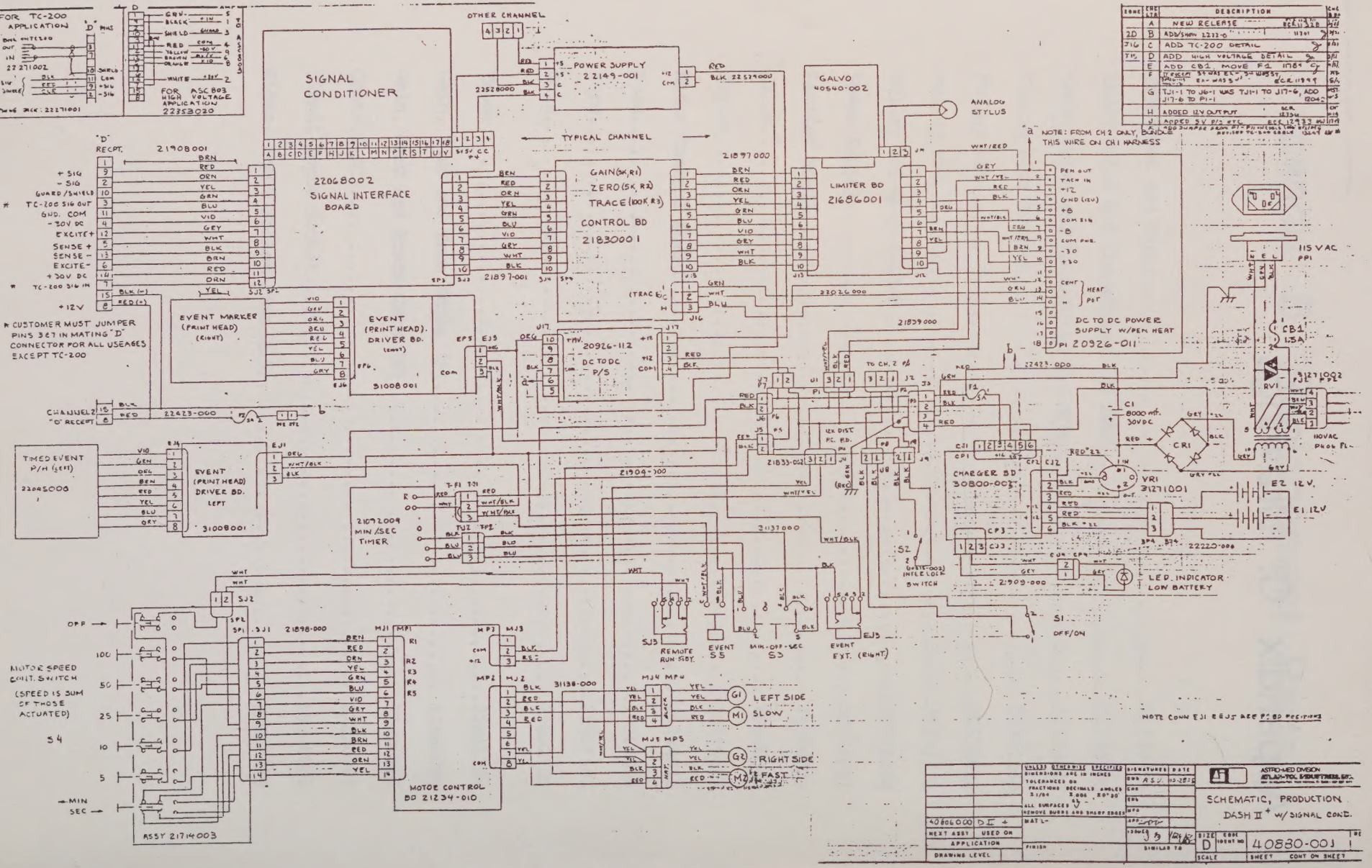
In no event will Astro-Med be liable for any incidental or consequential damages arising from the purchaser's inability to use the product.

Please refer any questions regarding warranty or repair to our customer service department (401) 828-4000.

Appendix B. Replacement Parts

Printhead and Cable	21123004
Chart Drive and Connection 120 RPM	21120000
Chart Drive and Connection 1.0 RPM	21120005
Timing Belt 3/16 W	20391160
Pulley 16T	20392016
Pulley 33T	20393333
Pulley 30T with Clutch	20525030
Power Supply	20926011
Limiter Board	21686001
Galvo	40540002
Stylus	20695002
Motor Control Board	21234010
Fuse	10364004
Zero	21801502
Gain	21802502
Trace	21801104
Gain, Zero and Tace Knobs (6)	11406004
Gain, Zero and Trace Caps (6)	11406002
Control PCB	21830001
Signal Input Socket	10909001
Signal Input Socket Pins (15)	10910002

Appendix C. Drawings



ZONE	LTR	DESCRIPTION	ECN
	A	NEW RELEASE	ECR 11320
2D	B	ADD/SHOW 22220-0	11701
J16	C	ADD TC-200 DETAIL	
T15	D	ADD HIGH VOLTAGE DETAIL	
	E	ADD CB1, MOVE F1	11789
	F	IT WAS ST WAS EXT SW WAS ST SPECIFIED EXT WAS S ECR 11999	
	G	TJ1-1 TO J6-1 WAS TJ1-1 TO J17-6, ADD J17-6 TO P1-1	ECR 12042
	H	ADDED 12V OUTPUT	ECR 12396
	J	ADDED 5V P/S ETC. ADD JUMPER FROM P1-P1 REVISED TC-200 CABLE	ECR 12933

40806000 DE	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES ±1/64 ±.005 ±0°30' ALL SURFACES REMOVE BURRS AND SHARP EDGES	DESIGNED	DATE	ASTRO-MED DIVISION ASTRO-TECH INDUSTRIES, INC.
		DWN A.S.V.	10-28-76	SCHEMATIC, PRODUCTION DASH II+ W/SIGNAL COND.
		CHK		
		ENG		
		MFG		
	MAT'L	APP		
NEXT ASSY USED ON		ISSUED		SIZE D CODE IDENT NO 40880 DWG NO 40880-001 REV J
APPLICATION	FINISH	SIMILAR TO		SCALE SHEET CONT ON SHEET
DRAWING LEVEL				